PROJECT HELP - ENHANCED COMMUNICATIONS IN EMERGENCIES BY CREATING AND EXPLOITING SYNERGIES IN COMPOSITE RADIO SYSTEMS

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PROJECT PRESENTATION

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Abstract. - This document contains a short description of the main goals, key issues and expected achievements of the project.

Keywords List: Emergency communications, composite radio systems, network sharing, spectrum sharing.

[1] Dissemination level codes: **PU** = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
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EXECUTIVE SUMMARY

This document contains a short description of the main goals, key issues and expected achievements of the project.

REVISION HISTORY

Version	Date	Author(s)	Description
0.1	15.02.11	O.Sallent, R.Ferrus	First version
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TABLE OF ACRONYMS

Acronym	Description
3GPP	3rd Generation Partnership Project
CEPT	European Conference of Postal and Telecommunications Administrations
EC DG	European Commission Directorate-General
EMTEL	Emergency Telecommunications
ETSI	European Telecommunications Standards Institute
ETSI TC	ETSI Technical Committee
FRONTEX	European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union
IEEE	Institute of Electric and Electronic Engineers
IMS	IP Multimedia Subsystem
IP	Internet Protocol
OAB	Operator Advisory Board
PMR	Private Mobile Radio
PSC-E	Public Safety Communication Europe
RRS	Reconfigurable Radio Systems
TETRA	Terrestrial Trunked Radio
TV	Television
UAB	User Advisory Board
UHF	Ultra High Frequency
UN	United Nations
WiMAX	Worldwide Interoperability for Microwave Access

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1. Introduction

Wireless communication scenarios are characterised by the coexistence of a variety of radio communication systems. Wireless networks differ from each other in the specific air interface technology, supported services, bit rate capabilities, coverage, mobility support, etc. Whilst different applications and needs have led to the deployment of such heterogeneous networks (e.g. commercial cellular systems, public-safety, etc.), all of them respond to society's fundamental demand for communications.

Wireless communications technologies play an irreplaceable role in emergency and disaster relief situations. Appropriate communications between first responders, authorities and citizens is crucial. It is generally acknowledged that existing wireless communication networks frequently fall short of meeting users' needs and consequently cannot properly support the management of these critical situations.

Even though the public safety community's technological needs have been understood for a long time [1][2], the capabilities of current public safety communications systems (e.g. Private Mobile Radio, PMR) are still lagging far behind some of the capabilities available in commercial mobile networks [3][4]. Some of the major limitations of public safety systems in emergency and disaster relief scenarios are:

- Lack of network capacity in emergency scenarios. Whilst the PMR network operators have optimised the use of their communication systems in their day-to-day service, the situation changes dramatically when an emergency causes additional stress for the system (and the operators). Emergency scenarios usually lead to exceptionally high traffic loads, that a single (e.g. PMR) wireless communication system may not be able to support. This situation can be worsened in scenarios with limited radio coverage (e.g., a traffic crash in a tunnel) or when parts of the communications infrastructure are damaged in the incident area.
- Lack of interoperability. The diversity of technologies used by public safety organisations often inhibits the cooperation between different agencies. Moreover, even when using the same technology, the networks can't interoperate and the constraints on the security level constitute an additional barrier. As a result, first responders are frequently required to manage several separate (often incompatible) radiocommunication systems. Furthermore, the political evolution of Europe has called for an increased collaboration among public safety organisations from different European countries. This has increased the need for harmonised procedures and interoperable technologies.
- Lack of support for broadband data rates. The evolution of public safety operations has created the need for applications where large amounts of data are exchanged between first responders or between the tactical front line responders and multi levels of a hierarchical command structure. Data-intensive multimedia applications have a great potential to improve the efficiency of disaster recovery operations (e.g. real-time access to critical data such as high resolution maps or floor plans, on-field live video transmission from cameras on helmets to a central unit, telemedicine, etc.).

Furthermore, emergency and disaster relief situations exhibit additional inherent challenges that often impose severe difficulties on public safety communications. Examples of these are:

- The locations where emergency and disaster relief operations occur are unpredictable and the availability of communications facilities is not guaranteed in the incident area.
- Even if wireless communications infrastructure exists in the incident area, the first responders may not have the appropriate terminals.
- Public safety responders need wide area coverage, e.g., in the event of natural disasters like earthquakes or flooding, where a large area may be affected.

- Public safety organisations must operate in uncertain conditions and difficult environments both from a physical as well as from a radio propagation point of view, due to the presence of interferences or obstacles.
- Public safety responders have special requirements regarding reliability, responsiveness and security of their communication systems.

Based on these observations, it is evident that more efficient and effective advanced wireless communication solutions than today's PMR systems are needed. In this context, Project HELP will establish a comprehensive solution framework aspiring to significantly enhance the secured communications resilience and responsiveness in emergency situations.

2. Main goals

Only a solution that takes into account multiple wireless communications technologies and strategies can address the complex requirements of modern emergency and disaster relief communications. Therefore, the proposed solution framework is built on the two following pillars:

- The capacity and efficiency of public safety communications networks can be increased by implementing "network sharing" concepts between different PMR networks (e.g., a PMR network belonging to a given public safety organisation is made available to other first responder agencies that participate in the crisis management) as well as between PMR and commercial cellular networks. In addition to cellular networks, other communications infrastructures (e.g., broadcast networks) can also be considered for integration with public safety communication systems. Hence, existing communication resources in the incident area will be potentially exploited for use by public safety organisations as well as for direct communication with the population. "Network sharing" refers to the capability of sharing network resources like traffic capacity, communication services and broadband connectivity between networks, which may have been designed for different tasks. This approach is particularly beneficial since it is very unlikely that a new private globally harmonised public safety multimedia communication solution will be introduced in the foreseeable future. On top of political and competitive obstacles, the comparatively small volume of the PMR market in comparison with commercial cellular networks would make it difficult to realise the immense investments required for such a task.
- Network capacity and efficiency can be increased by implementing "spectrum sharing" techniques between public safety and commercial networks in case of emergencies or natural or man-made disasters. "Spectrum sharing" refers to the possibility of managing spectrum in a flexible way, such as: both public safety and commercial communication services can be provisioned over the same frequency bands (e.g., allocate a public safety licensed band with mechanisms for interruptible spectrum leasing to commercial devices), sharing spectrum between different public safety license holders (e.g., spectrum pooling concept), exploiting spectrum opportunities over other licensed bands (e.g. TV bands) without causing harmful interference, dynamic frequency planning over the pool of licensed frequencies in order to meet the requirements arisen in an emergency situation, etc. As a whole, the ultimate target of "spectrum sharing" mechanisms is to provision further spectrum availability in the incident area together with suitable management functionalities.

2.1 Main objectives

Project HELP will pursue two major objectives:

- To define a solution framework –based on "network sharing" and "spectrum sharing" principles- for public safety communications able to exploit and properly coordinate available wireless communications systems in an incident zone, including those whose main usage is not for public safety communications (e.g. cellular, broadcast, etc.).
- To identify the required operational and management features and related functionalities of the established communications framework to achieve a synergic and holistic operation of the diverse wireless infrastructures.

As a result, Project HELP will provide a system concept and associated management framework together with a consolidated basis and roadmap for the realisation of the envisioned solution, which will be able to:

- Provide emergency communications services, including broadband communications, in the affected area.
- Provide required interoperability among communication infrastructures available in the area.
- Operate across a wide frequency range with different spectrum management mechanisms.

- Facilitate the operation of ad-hoc networks in the incident area.
- Flexibly and smartly adapt coverage and capacity to dynamically varying operative conditions.
- Ensure that data is protected according to its sensitivity level and that access to communication channels is only granted to authorised persons.

2.2 Detailed objectives

As stated above, Project HELP will establish the technical foundations and a strategy development roadmap for a solution framework aimed at increasing the wireless communication capabilities of public safety organisations by proposing innovative approaches for the management of network and spectrum resources. Project HELP activities which will be addressed on the basis of three major considerations:

- Project HELP will capitalise relevant work done in other organisations and projects in Europe from the point of view of users, regulators, industries and research bodies. Building on a thorough understanding of the state-of-the-art as well as of the limitations of related reference designs, the concepts and solutions proposed in Project HELP clearly represent a source of innovation in this strategic field.
- Project HELP is distinctly oriented towards the establishment of a solid solution framework intended to exploit synergies between wireless technologies for commercial services and public safety communications. Stretching the gap between both domains is believed to foster the evolution and capabilities of public safety communications systems and avoid the current situation where public safety communications systems lag far behind capabilities available in commercial mobile networks. Project HELP intends to define a specific solution framework backed by a qualified critical mass so that it can constitute a solid basis for the development of specific solutions.
- Project HELP will maximise the impact of its results, thus meeting one of the principal expectations of European society. In this way, networking and dissemination will play an important role in the project. Connections will be established with the most relevant organisations. This is a key point to reach expected critical mass and a solid consensus building towards the definition and adoption of a clear strategy for the realisation of advanced public safety communications.

Over such a basis, the detailed objectives of Project HELP are stated as follows:

Objective 1: *To identify operational user requirements, scenarios and overall system requirements*.

Project HELP will identify and describe the most critical public safety operational scenarios with respect to the need for communication resources as well as challenging radio communication environment. The scenarios will be created jointly with public safety users from diverse emergency service organisations and from as many countries across Europe as possible. Envisioned scenarios cover large-scale incidents that would require a coordinated response from crisis managers and first responders from different agencies across Europe and with resources from all levels of government. Based on the description of the operational scenarios and user requirements, the system requirements for a flexible and secure composite wireless communications solution will be defined.

Objective 2: *To define a solution framework (system concept) for the provision of public safety communications over diverse wireless infrastructures*.

The system concept definition will be addressed by conducting a feasibility study that will cover aspects such as:

- Defining the role that each system should take attending to its capabilities and the corresponding techniques and solutions that should be implemented to enable efficient interoperation among all involved systems.

- Determining required features and functionalities, changes/extensions that will enable the use of commercial systems, based on, e.g., 3GPP and IEEE 802.x standards, for public safety communications in emergency and disaster relief operations. In particular, capabilities for network sharing and traffic prioritisation will be considered. Furthermore, the potential support of specialised PMR-like services over mainstream cellular technologies (e.g. group services) will also be covered. Finally, the support of public networks may not be limited to emergency situations, e.g. public safety users could also use these networks during routine operation.
- Determining internetworking solutions between public safety and commercial communication systems. In particular, interworking solutions between PMR networks (e.g. legacy TETRA networks, more advanced solutions conceived around advanced packet switching networks) and public wireless access networks (e.g. 3GPP networks, WiMAX, 802.11-based networks) will be addressed so that public safety communications services can be provided over the two types of networks in an incident area. As well, interoperability between diverse PMR technologies used in the distressed area will be considered. These mechanism should cover technical issues, related to mobility, security and handling of access rights to the involved wireless systems.
- Analysing the feasibility of introducing specialised IP-based service platforms for public safety communications. In this regard, IMS-based platforms for emergency and first responder networks supporting most of the functionality required by emergency networks can be envisioned so that these platforms can be reachable from the diverse wireless networks. These platforms can support, e.g., specific directory and presence services allowing the crisis management authorities to contact the relevant emergency resources where ever they are located and whatever communication networks they are using.
- Determining new spectrum usage models to enhance communications in emergency scenarios by means of proper spectrum management mechanisms among PMR and commercial radio technologies, including the operation of fast deployable communication systems. In this context, innovative spectrum usage models enabled by the development of dynamic spectrum access technologies like cognitive radio will be considered. Advanced forms of exclusive spectrum usage rights (e.g. governed by a spectrum broker) together with spectrum commons and opportunistic spectrum access (e.g., opportunistic usage of white space in the UHF TV bands) will be considered for the overall solution, which may require the combination of several approaches together with dynamic network planning.
- Ascertaining the qualitative benefits of the availability of additional communications resources from several heterogeneous systems for the communication capacity of the public safety and emergency services.

Objective 3: *To define a framework for the management of the composite emergency network.*

A feasibility study for the realisation of a flexible radio network operation and management framework will be addressed considering different management levels and principles:

- Inter-system management. Mechanisms to determine communication needs and capacity requirements of the affected zone attending to established operational crisis management requirements. Determination of the operational configuration and capacity planning requirements of each network within the composite emergency system have to be derived attending to the capabilities supported by each available network.
- Intra-system network management. A range of management mechanism will be analysed (e.g. dynamic network planning, radio resource management algorithms, flexible spectrum management strategies) in order to cope with the particular role and communication requirements of each involved system while enabling the synergic operation of the composite radio networks. The proposed solutions will consider that the drivers for these mechanisms in emergency scenarios can be quite different than those considered in normal network operation

(e.g., reliability can be a crucial driver instead of improving system capacity, user/services prioritisation can also be a key issue). Specific mechanisms to cope with agile infrastructure-based deployment (e.g. portable base stations) will also be considered.

- Terminal equipment management. Different operational modes (e.g. infrastructure-based, direct) will be considered along with their corresponding management mechanisms. Capabilities and management criteria enabling opportunistic spectrum access for terminals operating in direct/ad-hoc modes will be of particular relevance.
- The conception of the overall management framework will consider self-management, autonomic-management and cognitive-management as potential driving factors. Furthermore, concepts such as "virtual networks for public safety communications", where the creation of virtual logical self-organising network on top of existing network technologies is envisioned in order to reduce complexity and facilitate immediate availability, will be further elaborated.

Objective 4: *To conduct a techno-economic analysis.*

The economic impact that the novel technical solutions proposed in Project HELP may have on the involved stakeholders (e.g. administrations, network operators) will be investigated. Recommendations regarding business models as well as desirable standardisation and regulatory actions will be developed. In particular, some aspects that will be considered are:

- Cost savings by sharing existing commercial networks instead of deploying and operating private networks.
- Leveraging technology investments targeted at a user population that is orders of magnitude larger than the PMR market.
- Enhanced network features which may appeal attractive (high average revenue per user, low churn) to new user groups (professional users).
- Shared access to otherwise unavailable spectrum.
- Analysing the feasibility of adapting commercial networks to public safety needs in case of emergencies in terms of investigating measures to offset possible economic impacts on the network operator.

Objective 5: *To establish a consolidated basis and roadmap for the realisation of the envisioned solution framework.*

Project HELP dissemination plan is strongly committed towards the achievement of a qualified wide awareness and support of relevant end users, European industry and research community so that the resulting solution framework will firmly constitute a solid basis and establish a clear roadmap for a future realisation of better public safety communications.

Project HELP will establish links with other relevant bodies or organisations to reach expected critical mass and establish a consolidated basis for the envisioned emergency composite network system:

- A User Advisory Board (UAB) and an Operator Advisory Board (OAB) will be established to validate system requirements and the envisioned system concept and solution framework respectively.
- Two Workshops will be organised to provide an independent validation process and dissemination of the projects objectives and developments.
- Project HELP will establish links with regulatory and standardisation organisations, which are working on the evolution of public safety communications. This includes ETSI TC TETRA, ETSI TC RRS, ETSI TC EMTEL, CEPT, the relevant agencies and DGs of the European Commission and FRONTEX. Liaison with the UN responsible for the Tampere Agreement on Public Safety Communications is also envisaged.

- Links will be established with ongoing projects in the same area like Public Safety Communication Europe (PSC-E), EULER and others.

The objective is to maximise the visibility and the effect of Project HELP results in the regulation and standardisation processes.

A clear roadmap will be established to drive future research activities. This roadmap will be the basis for a potential proposal of a large scale phase II demonstration project aimed at consolidating the HELP system concept by developing specific solutions (functional specifications, mechanisms and algorithms) and assessing their performance and experimental validation.

3. Expected achievements

In order to attain the objectives, the project has established a work plan that is summarised in Section 3.1. The development of the work plan will lead to the tangible results listed in Section 3.2. Contractual documentation to be delivered to the Commission is listed in Section 3.3. Finally, details to access all public documentation related to the project in the project's website are provided in Section 3.4.

3.1 Work planning

The project is structured into 4 work packages (WPs):

- *WP1. Project Management.* This WP covers the organisation and administration of the project in order to fulfil the milestones of the project (steering management), and the handling of the technical evolution and development of the project (technical management). The specific tasks to be conducted in this WP are:
    - Task 1.1 Consortium management.
    - Task 1.2 Technical management.
- *WP2. Operational User Requirements, Scenarios, System Requirements and Techno-economic analysis.* WP2 provides the reference point of the project for operational user requirements and scenarios, system requirements and techno-economic considerations and, therefore, establishes the operational environment for the development of the system concept and management framework in WP3. The specific tasks to be conducted in this WP are:
    - Task 2.1 Definition of operational user requirements and scenarios.
    - Task 2.2 Definition of system requirements.
    - Task 2.3 Techno-economic analysis.
- *WP3. Solution Framework Definition: System concept and functional model.* WP3 encompasses the core activities within Project HELP aimed at defining the envisioned solution framework. A tight interaction is needed with both WP2 and WP4. The specific tasks to be conducted in this WP are:
    - Task 3.1 Network sharing solutions.
    - Task 3.2 Spectrum sharing solutions.
    - Task 3.3 Solution framework: system concept.
    - Task 3.4 Solution framework: system design and management framework.
- *WP4. Impact and Momentum.* WP4 constitutes a pivotal WP within Project HELP, since it will promote the ideas developed within the project to a broad scientific community, standardisation fora and will pursue the required consensus building for the envisioned Project HELP system concept. The specific tasks to be conducted in this WP are:
    - Task 4.1 Workshops organisation.
    - Task 4.2 Dissemination & Networking.
    - Task 4.3 Roadmap for the realisation of the envisioned solution framework.

The graphical presentation of the WPs is depicted in Figure 1, presenting at a summary level the relationship between WPs. The timeline of the different WPs and Tasks is shown in Figure 2. The official start of the project has been 1st February 2011 (i.e., M1=February 2011).

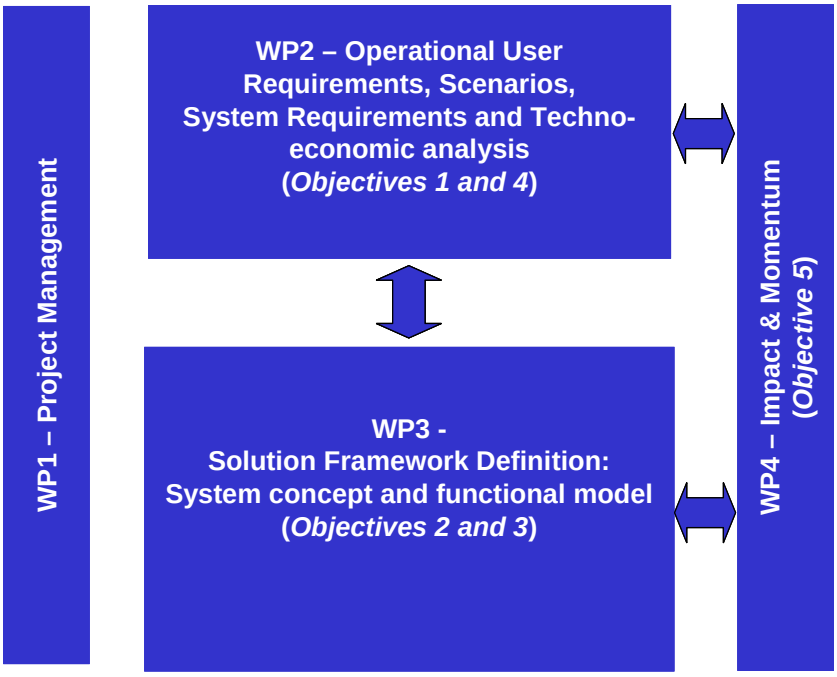

Figure 1: Graphical representation of the work packages

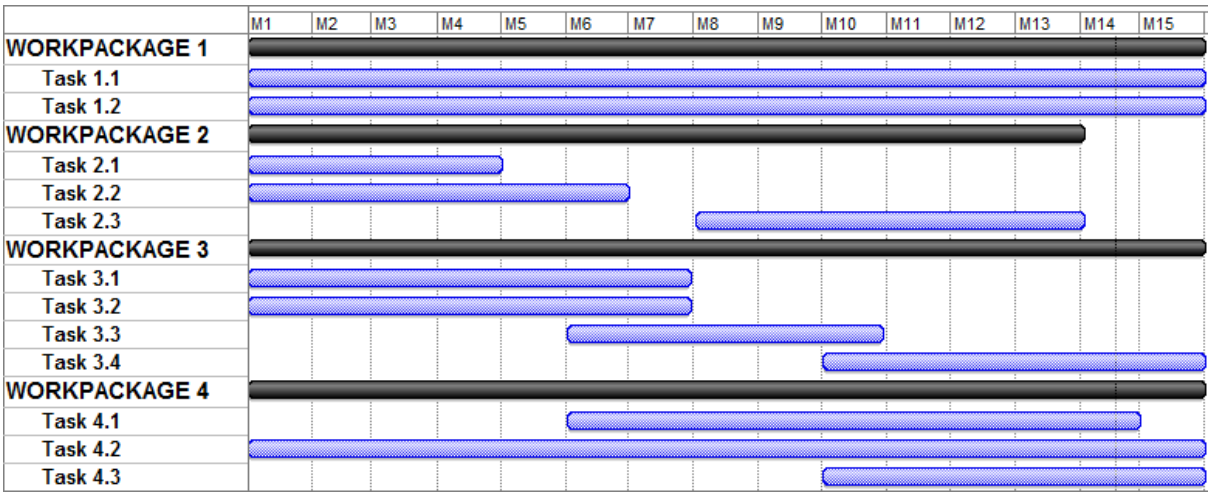

Figure 2: Project HELP timeline.

3.2 Tangible results

The tangible results to be achieved can be summarised as follows:

- Documentation with key operational scenarios and system requirements (WP2 achievement).
- Documentation with the techno-economic assessment of the envisioned system concept (WP2 achievement).
- Documentation about the feasibility studies to determine potential design choices for network and spectrum sharing solutions (WP3 achievement).
- Documentation defining the system concept, high level system design and associated management framework (WP3 achievement).

- Establishment of a User Advisory Board (UAB) and an Operator Advisory Board (OAB) (WP4 achievement).
- Organisation of two Workshops with representatives from end-users, regulatory, industry and research entities (WP4 achievement).
- Documentation establishing a roadmap for the realisation of the envisioned solution framework (WP4 achievement).
- Dissemination of Project HELP outcomes to public safety response entities across Europe, other EC projects, regulatory and standardisations bodies (e.g., relevant ETSI TCs, CEPT and relevant EC DGs) (WP4 achievement).

3.3 List of deliverables

The list of deliverables to be provided by Project HELP is compiled in Table 1.

Table 1: List of deliverables

Number[2]	Deliverable Title	WP	Nature[3]	Dissemination level[4]	Delivery date[5]
D1.1	Project presentation	WP1	R	PU	M1
D1.2	Project management guidelines	WP1	R	RE	M1
D1.3	Interim progress report	WP1	R	RE	M8
D1.4	Final management report	WP1	R	RE	M15
D2.1	Description of operational user requirements and scenarios	WP2	R	RE	M4
D2.2	Definition of system requirements	WP2	R	RE	M6
D2.3	Techno-economic analysis	WP2	R	RE	M13
D3.1	Analysis of network and spectrum sharing solutions	WP3	R	RE	M7
D3.2	System concept for enhanced communications in emergencies	WP3	R	RE	M10
D3.3	System design and management framework for enhanced communications in emergencies	WP3	R	RE	M15
D4.1	Dissemination plan	WP4	R	RE	M2
D4.2	Workshop #1 report	WP4	R	RE	M9
D4.3	Workshop #2 report	WP4	R	RE	M14
D4.4	Report on dissemination and networking	WP4	R	RE	M15
D4.5	Roadmap	WP4	R	RE	M15

[2]Numbering convention is <WP number>.<number of deliverable within that WP>
[3]Nature of the deliverable: **R** = Report
[4]Dissemination level:
PU = Public
RE = Restricted to a group specified by the consortium (including the Commission Services).
[5]Measured in months from the project start date (month 1).

3.4 Follow-up of public achievements

All public documents reflecting the achievements of the project will be available at Project HELP's website (http://www.fp7-sec-help.eu), which will be regularly updated.

4. Conclusion

This document has presented a short description of the main goals, key issues and expected achievements of the project.

5. References

[1] Final Report of the US Government's Public Safety Wireless Advisory Committee (PSWAC). Available on-line from http://www.ntia.doc.gov/osmhome/pubsafe/pswac_al.pdf

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[4] The Public Safety Nationwide Interoperable Broadband Network: A New Model for Capacity, Performance and Cost. FCC White Paper, June 2010